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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/749,196	12/30/2003	Robert S. Chau	42P17294	9938

7590 06/27/2005

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EXAMINER

BLUM, DAVID S

ART UNIT PAPER NUMBER

2813

DATE MAILED: 06/27/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/749,196

Applicant(s)

CHAU ET AL.

Examiner

David S. Blum

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-30 is/are pending in the application.
- 4a) Of the above claim(s) 28-30 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 17-28 is/are allowed.
- 6) ☒ Claim(s) 1-6 and 8-11 is/are rejected.
- 7) ☒ Claim(s) 7 and 12-16 is/are objected to.
- 8) ☒ Claim(s) 1-30 are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. ____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____. |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>4/27/05</u> . | 6) <input type="checkbox"/> Other: ____. |

This action is in response to the preliminary amendment filed 2/20/04.

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
 - I. Claims 1-27, drawn to a method of making a semiconductor device, classified in class 438, subclass 183.
 - II. Claims 28-30, drawn to a semiconductor device, classified in class 257, subclass 213.

The inventions are distinct, each from the other because of the following reasons:

2. Inventions I and II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the transistor of the device claims need not be fabricated by forming and removing a dummy (sacrificial) gate and a sacrificial dielectric layer.
3. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.
4. Because these inventions are distinct for the reasons given above and the search required for Group I is not required for Group II, restriction for examination purposes as indicated is proper.

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5. During a telephone conversation with Michael A. Bernadicou on 6/22/05 a provisional election was made with oral traverse to prosecute the invention of Group I, claims 1-27. Affirmation of this election must be made by applicant in replying to this Office action. Claims 28-30 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

6. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 1-6 and 8-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hanafi (US006660598B2) in view of Lin (US006475908B1) and Sugishima (US4352724):

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Hanafi teaches all of the positive steps of claims 1-6 and 8-11 except for the wet etch removal of the dielectric layer.

Regarding claim 1, Hanafi forms a sacrificial gate electrode (24) on a substrate (10), sidewall spacers (26) are formed on the sides of the gate, a sacrificial inter-level dielectric layer (28) is formed, the sacrificial gate is removed (column 4 lines 52-53), replacement gates are formed (column 5 lines 30-55), the replacement gate and sacrificial dielectric are polished (column 6 line 2 planarization), and the inter-level dielectric layer is removed (column 6 lines 10-12).

Hanafi teaches that the replacement gate and sacrificial dielectric are planarized, but does not teach the method of planarization. Lin teaches CMP (polishing) the replacement gate and dielectric layer to planarize (column 5 lines 47-50).

Hanafi is also silent as to how the dielectric material is removed, other than to teach a highly selective etch. Sugishima teaches that it is known to wet etch silicon oxide with HF.

Regarding claim 2, the sidewall spacers are silicon nitride (column 4 line 38).

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Regarding claim 3, the sacrificial dielectric layer is HDP (thus chemical vapor deposition) oxide or deposited TEOS (soft CVD).

Regarding claim 4, the replacement gate is formed to the height of the sacrificial dielectric, therefore the planarization would remove only a negligible amount of the replacement gate, thus less than 50 angstroms. Also, Lin teaches a gate height (prior to planarization) of as little as 500 angstroms. A removal of more than 50 angstroms in a planarization step would be impractical.

These ranges are considered to involve routine optimization while it has been held to be within the level of ordinary skill in the art. As noted in *In re Aller* (105 USPQ233), the selection of reaction parameters such as temperature and concentration would have been obvious:

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art. Such ranges are termed "critical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

In re Aller 105 USPQ233, 255 (CCPA 1955). See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

One skilled in the requisite art at the time of the invention would have used any ranges or exact figures suitable to the method in the process of forming a gate regarding temperature, and dimensions using prior knowledge, experimentation, and observation

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with the apparatus used in order to optimize the process and produce the gate structure desired to the parameters desired.

Regarding claim 5, the removal by wet etching would remove remaining defects from polishing the dielectric layer and gate because the material is removed as in the instant specification.

Regarding claim 6, Sugishima teaches a wet etch of HF (Table I, thus an aqueous hydrofluoric acid).

Regarding claim 8, Hanafi does not teach heating the material to remove it by conventional means, thus the material is at 20 degrees. Sugishima does not teach heating the wet etchant to remove material, thus the temperature would include 20 degrees.

Regarding claim 9, Neither Hafani nor Sugishima teach the duration of etching. One skilled in the art would know, or know with out undue experimentation how long to etch to remove material. This then would be optimization of variables as above.

Regarding claim 10, the etchant and the material to be removed are the same as in the instant specification, therefore the etch selectivity would also be at 10:1.

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Regarding claim 11, the replacement gate is formed to the height of the sacrificial dielectric, therefore the planarization would remove only a negligible amount of the replacement gate, thus less than 10 angstroms. Also, Lin teaches a gate height (prior to planarization) of as little as 500 angstroms. A removal of more than 10 angstroms in a planarization step would be impractical.

It would be obvious to one skilled in the requisite art at the time of the invention to modify Hanafi by including CMP as the planarization method as taught by Lin, and to include a wet etch as the removal method as taught by Sugishima. One skilled in the art would use known conventional processes whenever possible rather than to spend research time and money to replace working conventional methods.

Allowable Subject Matter

9. Claims 7, 9, and 12-16 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim 7 limits the etchant to including ethylene glycol. This limitation, in combination with the other limitations of claim 7 is not taught or suggested by the prior art of record. Hanafi (US006686630B2, US006841831B2, and US006660598B2) nor Lin (US006677652B2 and US006475908B1) do not teach a surfactant of ethylene glycol with the hydrofluoric acid.

Claim 12 limits the etchant to a titanium nitride etch in sulfuric acid and hydrogen peroxide mixture at 70 degrees C. This limitation, in combination with the other limitations of claim 12 is not taught or suggested by the prior art of record. Although Hanafi teaches dielectric layers of titanium nitride, none of Hanafi (US006686630B2, US006841831B2, and US006660598B2) nor Lin (US006677652B2 and US006475908B1) teach a titanium nitride etch in sulfuric acid and hydrogen peroxide mixture at 70 degrees C.

Claim 13 is dependent upon claim 12.

Claims 14-16 limit the method to depositing a nitride etch stop layer. This limitation, in combination with the other limitations of claim 14 is not taught or suggested by the prior art of record. Hanafi (US006686630B2, US006841831B2, and US006660598B2) nor Lin (US006677652B2 and US006475908B1) do not teach the formation of an etch stop layer.

10. Claims 17-27 are allowed.

Claim 17 limits the method to depositing a nitride etch stop layer creating stress in the underlying structure. This limitation, in combination with the other limitations of claim 17 is not taught or suggested by the prior art of record. Hanafi (US006686630B2, US006841831B2, and US006660598B2) and Lin (US006677652B2 and

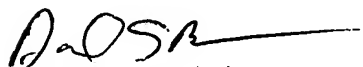
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US006475908B1) do not teach the formation of an etch stop layer creating stress in the underlying structure.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David S. Blum whose telephone number is (571)-272-1687) and e-mail address is David.blum@USPTO.gov .

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr., can be reached at (571)-272-1702. Our facsimile number all patent correspondence to be entered into an application is (703) 872-9306. The facsimile number for customer service is (703)-872-9317.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



David S. Blum

June 23, 2005